



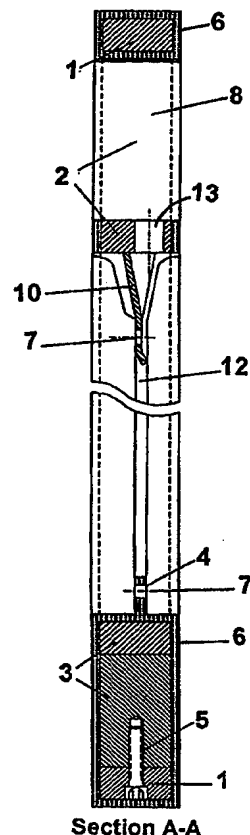
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>C25B 9/00, 13/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 97/00979</b> <b>(43) International Publication Date:</b> 9 January 1997 (09.01.97)
<b>(21) International Application Number:</b> PCT/NO96/00152 <b>(22) International Filing Date:</b> 19 June 1996 (19.06.96) <b>(30) Priority Data:</b> 952528 23 June 1995 (23.06.95) NO <b>(71) Applicant (for all designated States except US):</b> NORSK HYDRO A.S [NO/NO]; N-0240 Oslo (NO). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> D'ERASMO, Pietro [NO/NO]; Stivimovegen 18, N-3670 Notodden (NO). LYSFJORD, Roger, Mareno [NO/NO]; Asvallveien 48, N-3960 Stathelle (NO). <b>(74) Agent:</b> SUNDNES, Arne; Norsk Hydro a.s, N-0240 Oslo (NO).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** DIAPHRAGM ELEMENT FOR AN ELECTROLYTIC FILTER PRESS ASSEMBLY

**(57) Abstract**

The present invention relates to diaphragm elements for an electrolytic filter press assembly comprising anode and cathode compartments separated with diaphragms. The diaphragm elements comprise a frame (1) which is rigid steel covered by a flexible vulcanizable material (6) serving as electrical insulation and simultaneously sealing and being integrated with fastening means (4) with openings (7) for bolts for securing the diaphragm (12) to the frame (1). T-formed elements (2, 3) form gas/liquid channels with the frame (1) and are secured to same by bolts (5) and covered by material (6) being integral with the sealing/insulating material (6) around frame (1).



Section A-A

### **LEDIGLICH ZUR INFORMATION**

Codes zur Identifizierung von PCT-Vertragsstaaten auf den Kopfbögen der Schriften, die internationale Anmeldungen gemäss dem PCT veröffentlichen.

AM	Armenien	GB	Vereinigtes Königreich	MX	Mexiko
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## **Diaphragm element for an electrolytic filter press assembly**

The present invention relates to diaphragm elements in an electrolytic filter press assembly comprising anode and cathode compartments separated by diaphragms. Said diaphragm elements comprise a frame, openings for flow of gas and liquids respectively, diaphragm secured to the frame, sealing means and insulating means.

The electrolytic filter press assembly is primarily used for production of hydrogen and oxygen from brines, usually aqueous alkali hydroxide solutions. Similar cells are used for production of chlorine from sodium chloride solutions. Such cells can comprise steel frames or frames made of plastic materials. One advantage by using steel frames is that they are rigid and large filter press assemblies can then be made. However, steel frames necessitate insulation and sealing devices between the frames. Corrosion is also a problem to be dealt with. One way of dealing with the corrosion problem is nickel plating of for instance the surfaces of the diaphragm elements that are exposed to the brine or lye to be electrolyzed. But nickel plating is expensive and should be kept to a minimum.

Electrolyzers of the above type have been known for a long time and are described in numerous patents. In Norwegian patent No. 157024 there is described an electrolyzer of the filter press type for production of hydrogen and oxygen. Each cell consists of bipolar electrodes separated from each other by a

diaphragm element. The cells are kept together between two end plates in such a way that the electrolytic cells are kept under constant pressure by longitudinal bolts between said plates. In the electrolyzer's longitudinal direction, and at its upper part channels for hydrogen and oxygen, respectively are made in the cells. At the lower part of the cells are channels for circulating lye.

From EP 0212240 A1 there is known an apparatus for electrolysis of solutions comprising bipolar elements made up of a conductive plate peripherically surrounded by an insulating frame provided with feeding and discharging channels along peripheral zones of the frame itself. Separating elements can be inserted between said bipolar elements, consisting in a porous diaphragm and an insulating frame also carrying feeding and discharging channels.

The main object of the invention was to arrive at a new diaphragm element construction comprising application of steel frames such that large rigid dimensions could be achieved and at the same time attain a construction giving a simpler construction of electrolyzers having fewer elements than the present ones.

Another object was to arrive at a common arrangement for sealing, electrical insulation and protection against corrosion.

The main problem the inventors had to solve was the corrosion of the steel parts of the diaphragm element and how new and improved sealing and insulating means could be applied without making more complicated and expensive elements. During the development of new solutions to the problem it was found that the corrosion problem could be solved by conventional nickel plating of only minor parts of the diaphragm element and then covering the remaining exposed parts with a corrosion resistant material, for instance plastic or rubber material. Keeping in mind that the diaphragm element also had to be electrically insulated along its

circumference, the inventors started investigating the possibility of using the same material for corrosion protection, insulation and sealing. It was then found that not only could the same material be used, but by doing this it became possible to make a more simple and cheap diaphragm element. This was achieved by integrating the corrosion protecting coating of the steel parts of the element with the electrical insulation and the sealing of the diaphragm element.

Useful materials for making these integrated corrosion and insulating coatings were found to be vulcanizable rubber having the required electrical insulating and sealing properties.

By applying the above described principle, only minor parts had to be nickel plated and this could be performed in small nickel plating equipment. It was further found that some of the various elements of the diaphragm element did not have to be joined by welding as previously, but could simply be kept in place by the vulcanized rubber coating. Thus welding could to a great extent be substituted by vulcanization.

The main new features of the invention comprises that the frame 1 is rigid steel covered by a flexible, vulcanizable material 6 serving as electrical insulation and simultaneously sealing and being integrated with fastening means 4 with openings 7 for bolts for securing the diaphragm 12 to the frame 1.

Another special feature of the invention comprises that T-formed elements 2,3 form gas/liquid channels with the frame 1 and are secured to same by bolts 5 and covered by material 6 being integral with the sealing/insulating material 6 around the frame 1.

Preferably the diaphragm 12 is secured to element 2 by a nickel plated element 10 and to element 3 and the frame 1 by means of fastening means 4 being an integral part of the insulating/sealing material 6.

The scope of the invention and its special features are as defined by the attached claims.

The invention will now be further explained in connection with the description of the drawings:

Figure 1 shows a front view of a diaphragm element according to the invention.

Figure 2 shows a cross section of the diaphragm element of fig. 1 along line A-A

Figure 3 shows a cross section of the frame with insulating and sealing.

Figure 1 shows a circular shaped diaphragm element though the shape can also be rectangular or square. The outer frame of the element is a rigid steel frame 1 circumferented by an electrically insulating material 6 which also serves as sealant and is integral with fastening means 4 with openings 7 by which the diaphragm itself is fastened to means 4. T-formed elements 2 and 3 are secured to the frame 1 for forming respective gas channels 8 and lye channels 9. The T-formed elements 2 and 3 are kept in position by bolts 5 when the material 6 is brought onto said elements which thereby are secured gas and liquid impervious. These elements are covered by the material 6 which is vulcanized to said elements. The elements 2 and 3 have respective fastening means 10, 4 by which the diaphragm itself is secured to these elements. Fastening means 10 are nickel plated.

In figure 2 the cross section of the diaphragm element is shown along line A-A of figure 1. The cross section goes right through the T-formed element 3, and the lye channel 9 can accordingly not be seen on this figure. The diaphragm 12 is

secured by bolts through the openings 7 to the fastening means 4 and 10. The latter is nickel plated, while the former constitutes an integral part of the material circumferencing the steel frame 1. The opening 13 in element 2 is a gas passage from the electrolytic cell to the gas channel 8.

Figure 3 is a cross section of the circular frame and shows the steel frame 1 circumferenced by the insulating and sealing material 6 and the integral fastening means 4 made of the same material. The opening 7 is for the bolts which shall secure the diaphragm to the fastening means 4.

By the present invention numerous advantages have been obtained compared with existing solutions. The production costs have been substantially reduced as most of the nickel plating is substituted with vulcanization. As today's nickel plating will require expensive and large chemical baths, the production costs have been substantially reduced as most of the nickel plating is substituted with vulcanization. The electrolyzer will be more compact and the advantages of using the same material for corrosion protection, electrical insulation and sealing will be of great value and simplify the material requirements for the electrolyzer.

Claims

1. Diaphragm elements for an electrolytic filter press assembly comprising anode and cathode compartments separated by diaphragms (12), said diaphragm elements comprising a frame (1), openings (8,9) for flow of gas and liquid,  
c h a r a c t e r i z e d i n t h a t  
the frame (1) is rigid steel covered by a flexible, vulcanizable material (6) serving as electrical insulation and simultaneously sealing and being integrated with fastening means (4) with openings (7) for bolts for securing the diaphragm (12) to the frame (1).
2. Diaphragm elements according to claim 1,  
c h a r a c t e r i z e d i n t h a t  
T-formed elements (2,3) forming gas/liquid channels with the frame (1) are secured to same by bolts (5) and covered by material (6) being integral with the with the sealing/insulating material (6) around the frame (1)
3. Diaphragm elements according to claim 1,  
c h a r a c t e r i z e d i n t h a t  
the diaphragm (12) is secured to element (2) by a nickel plated element (10) and to element (3) and the frame (1) by means of fastening means (4) being an integral part of the insulating/sealing material (6).



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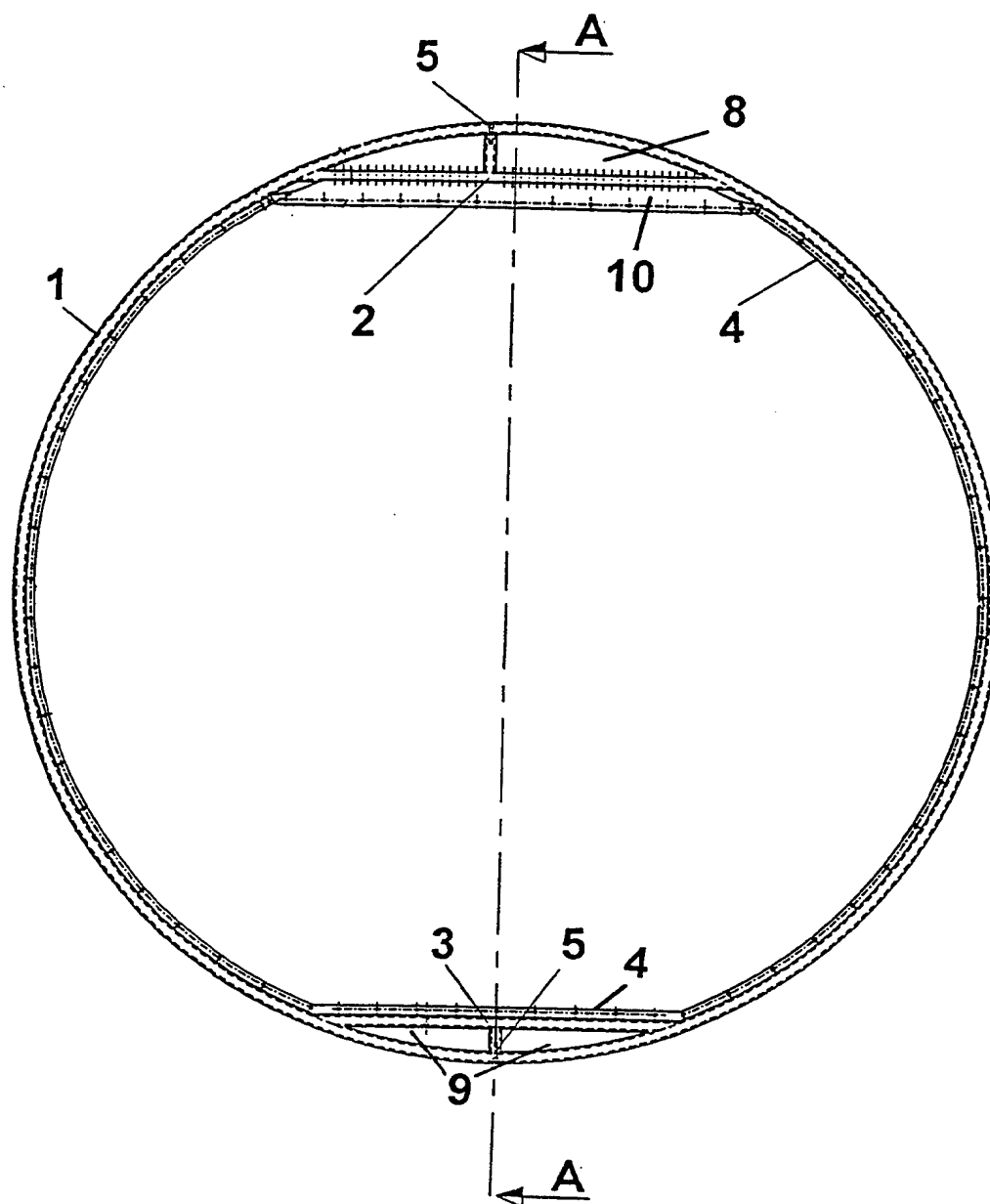


Fig. 1

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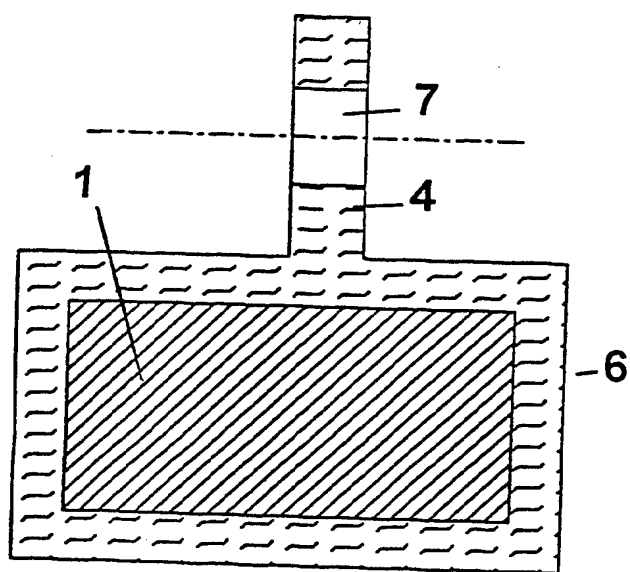


Fig. 3

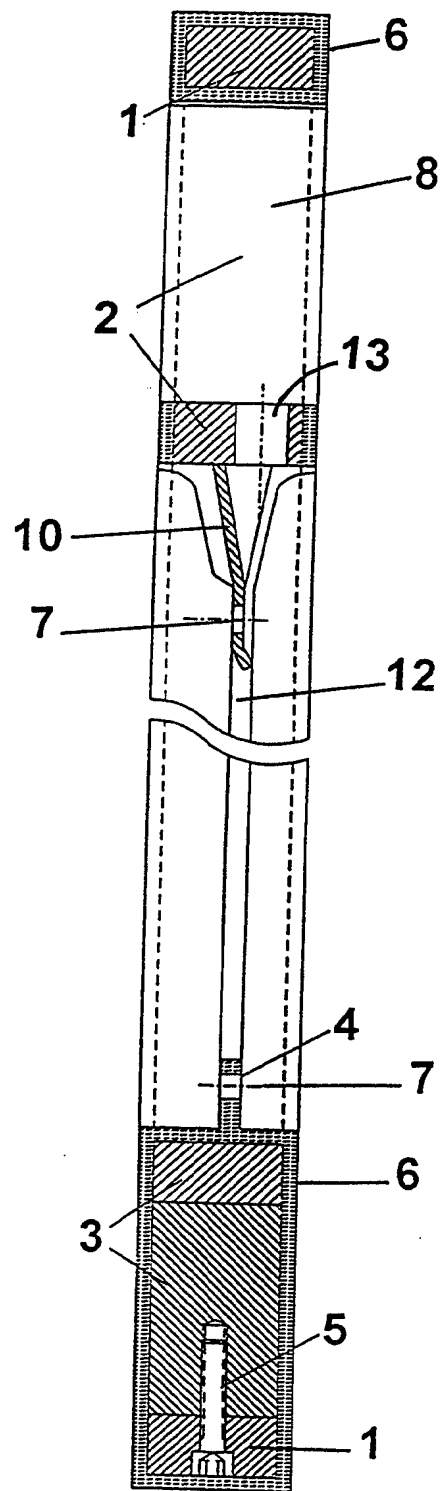


Fig. 2

Section A-A

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 96/00152

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C25B 9/00, C25B 13/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1508758 A (WILLIAM G. ALLAN), 16 Sept 1924 (16.09.24), page 2, line 100 - line 128  --	1-3
A	CH 312582 A (MASCHINENFABRIK OERLIKON), 29 March 1956 (29.03.56), page 1, line 44 - page 2, line 4  --	1-3
A	FR 631138 A (M. RODOLPHE PECHKRANZ), 15 December 1927 (15.12.27), page 1, line 43 - page 2, line 19  -- -----	1-3

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

3 October 1996

Date of mailing of the international search report

07-10- 1996

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

05/09/96

International application No.

PCT/NO 96/00152

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 1508758	16/09/24	NONE	
CH-A- 312582	29/03/56	FR-A- 1098419 GB-A- 752486	00/00/00 00/00/00
FR-A- 631138	15/12/27	NONE	